Robots in Need: Acquiring Assistance with Emotion

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***Abstract*—**
There will always be occasions where robots require assistance from humans. Understanding what motivates people to help a robot, and what effect this interaction has on an individual will be essential in successfully integrating robots into our society. Emotions are important in motivating prosocial behavior between people, and therefore may also play a large role in human-robot interaction. This research explores the role of emotion in motivating people to help a robot and some of the ethical issues that arise as a result, with the ultimate aim of developing suitable methods for robots to interact with humans to acquire assistance.

***Index Terms*—human-robot interaction, empathy, emotion, prosocial behavior**

I. Introduction

HitchBOT was a robot that relied on human help to explore the world [1]. Despite successfully traversing Canada and parts of Europe, it was found destroyed in a park in Philadelphia. It is not entirely clear what happened to hitchBOT, but the conclusion of this social experiment illustrates what can happen when a robot fails to convince people to help it. Understanding what motivates people to help, rather than hinder, a robot in need will be essential to successfully integrate robots into our world. It is also essential because the world is a complex, unpredictable place which presents challenges potentially beyond even the most advanced robots to overcome independently. Similarly, any robot designed to collaborate with humans will also need to master the skill of encouraging people to interact with it to achieve a shared goal.

Gaining assistance is a complex task that has been little explored in a human-robot interaction (HRI) context and requires an understanding of what motivates helping between people, and exploration of whether those same motivations apply to robots. The ethical implications of a robot that influences people's behavior and what effect the robot has on those interacting with it must also be explored.

II. Literature Review

Understanding what motivates helping between people is crucial in identifying what behaviours a robot could utilize to gain assistance.

Behaviour that is entirely for the benefit of others is sometimes referred to as 'true altruism' [2], [3], and could be particularly relevant to scenarios with robots since they share no familial relation to us, and depending on context, could be relying on assistance from strangers with little opportunity to reciprocate the helping behaviour.

Research investigating altruistic behaviour has consistently found that phenomena such as sympathy and empathy, which involve understanding and sharing in others' emotional experiences, are closely linked to prosocial behavior [4]. It is thought that by observing others' emotions, representations of these emotions are activated in the brain, thus inducing the same, or at least congruent, emotions in the observer [5]. The shared negative affect experienced, or concern for the other's negative feelings, prompts the observer to alleviate all party's distress by helping, assuming that the benefits of helping outweigh any costs [6]–[8].

While much of the literature has explored empathy for negative emotions, there is emerging evidence that positive emotion could also play a role. In this case, when someone is helped they respond positively, which could in turn evoke positive emotion in the helper, thus forming a positive feedback loop which could motivate prosocial behavior [2], [9], [10].

With emotion being an important motivator for prosocial behavior between people, it is important to consider how behaviors that look like emotion can be implemented on robots. Robots have successfully used a variety of modalities to convey emotion, including simple variations in movement patterns (e.g. [11]) to fully fledged facial expressions (e.g. [12]). It should be noted that all subsequent references to emotions shown by a robot, refer to behaviors that appear like emotion, rather than the generation of artificial emotion.

With robots capable of expressing emotion, research has begun to explore how robots can use this to gain assistance. Previous research has explored helping robots in a game scenario where a robot expresses negative emotions (usually sadness) about its performance and requests participants to help it by sacrificing their own performance [13], [14]. In these situations, participants would would often respond with empathy and help the robot, however occasionally people would respond with antipathy and actively hinder the robot to ensure their own performance was retained [14].

There are relatively few studies exploring people's responses to robots outside of the laboratory setting. In one such study, the authors found that few people helped a robot access an object out of its reach [15]. Though this study did not look specifically at the role of emotion on helping behavior, the scenario could be easily adapted to investigate with emotion.

Whilst emotion may be important in influencing how people respond when humans or robots require help, the general use of emotion with robots has raised ethical concerns [16]. Many of these concerns centre around the ethical implications of robots that deceive people, since they only present a facade of emotion. There has been particular debate about using emotion with robots designed to provide some form of care or assistance to humans [16], [17]. However, there has not yet, to the authors knowledge, been an experimental exploration of peoples perceptions of the acceptability of robots using emotion in this way.

Furthermore, work investigating the long term effectiveness of a robot using emotion to gain assistance is all but non-existent and thus requires exploration.

Therefore our research aims to draw from the literature of prosocial behavior to explore whether these motivations apply to robots. In particular this research aims to address gaps in the literature and explore the role of emotion and whether this is an effective and ethical means for a robot to elicit help.

III. Previous and Current Work

A. Positive and Negative Emotion

Using three behaviors developed in a preliminary experiment, this study aimed to explore the influence of both positive and negative emotions expressed by a robot on peoples willingness to help it.

In this experiment, participants (n=37) interacted with a tele-operated robot that performed one of three possible patterns of behavior. In the negative condition, the robot initially behaved neutrally, then expressed sadness while it required assistance and returned to neutral behavior as soon as it received help. In the positive condition, the robot remained neutral until it received help, whereupon it expressed happiness.

The results of this study suggested that emotional behavior displayed by the robot subtly increased how quickly people responded to the robot, compared to a neutral control condition. Furthermore, individuals with higher baseline empathy were quicker to help compared to less empathetic individuals, but only when the robot expressed sadness.

B. Ethics of Emotion

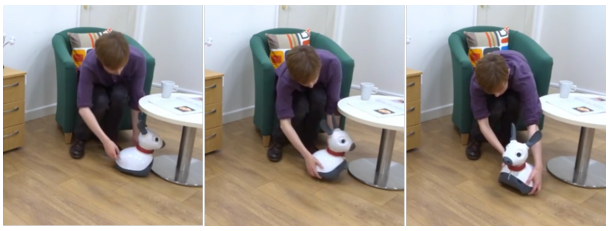

Fig. 1. A robot receives human assistance to recover from a collision

This experiment explored how using emotion to elicit help from a human affects judgments of the ethical acceptability of either a companion or assistive robot behaving in this way. In this online study participants (n=201) saw a robot, described as either a companion or assistive robot, moving around a home environment, getting stuck, and receiving help (See figure 1). When the robot required assistance it either showed sadness or remained neutral. Participants were asked to rate the ethical acceptability of the robot's behavior in each video. The results of this study suggested that whilst people did not rate the robots using emotion as entirely unethical, they did perceive them as less ethical than an entirely neutral one.

IV. Future Work

Future work will continue to explore the psychological outcomes of helping a robot, particularly whether phenomena such as 'helper's high', the increase in positive emotion felt after helping others [18], which forms a positive feedback loop in prosocial behavior between people, could also arise in interactions with robots. This will involve measuring people's mood pre and post interaction with the robot. If improvements to people's moods are observed, the influence of this on subsequent prosocial behavior towards the robot will be explored to see whether this is an effective means of encouraging people to continue helping a robot. If so, the benefits to both the robot and the user would be highly desirable, as it could effectively add additional functionality to robots (i.e. improving the user's mood) with little additional effort.

In addition, future work will explore how best to increase empathy and reduce feelings of antipathy towards a robot (as observed in some studies [14] and perhaps in hitchBOT's case) to further improve the probability of success in getting help. For example, the next set of experiments will explore whether varying the intensity of the emotion shown by the robot is associated with a quicker response to the robot and or greater levels of helping behavior. There will also be a continuing exploration of how the perceived authenticity of emotional behavior shown by the robot influences helping behavior. So far we have explored the ethical acceptability of robots using emotion to gain assistance, but do not know how people's attitudes to the robot in this regard influences people helping behaviour towards the robot.

The effectiveness of emotional behaviors with different robots will also be verified, as some research suggests that empathy felt towards a robot is influenced by its degree of anthropomorphism [19], which could in turn influence people's prosocial behavior. Similarly, a long term investigation of these behaviours in natural scenarios is required as robots become more common to ensure their continued effectiveness and ecological validity.

This research ultimately aims to provide an understanding of how people perceive and respond to robot behaviour. This will inform the design and implementation of robotic behaviours to acquire assistance from humans in a way that is effective, ethical and where possible mutually beneficial. Furthermore, this research aims to contribute to a future where humans and robots coexist, where people help robots on the occasions they cannot help themselves so that they can achieve what should be their primary function; helping us.

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